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Contributions to the knowledge of North American Sphagna. II.

C. WARNSTORF.

b. Stem leaves broadest at the base, distinctly narrowed upward, therefore more or less isosceles-triangular, mostly with an involute, truncate and dentate apex. Border much widened downward.

a. Stem leaves with or without fibrils in the upper half. Superficial cells of the stem cortex with very distant, irregularly disposed, ringless pores. Wood body never red or brown, generally yellowish or greenish. Branch leaves for the most part distinctly five-ranked, appressed or curved spreading. Usually monoicous, rarely dioicous; male branches red.

7. *S. quinquefarium* (BRAITHW.) WARNST. Hedw., 1885, p. 222-224.

Syn.: *S. acutifolium*, var. *quinquefarium* Braith. Sphagn. Eur. and N. Amer. (1880).

S. acutifolium, varr. *pachycladum* et *alpinum* Sendt.

S. acutifolium, var. *flavicaule* Warnst. Europ. Torfm. p. 50 (1881); var. *Gerstenbergeri* Warnst. Flora, 1882, p. 206; varr. *pallens* et *Silesiacum* Warnst. Hedw. 1884, p. 116 and 118.

S. plumosum Röll., var. *quinquefarium* (Braithw.); var. *Gerstenbergeri* (Warnst.); var. *Silesiacum* (Warnst.) Flora, 1886.

S. Warnstorfii Röll, var. *pallens*, (Warnst.); var. *pseudo-patulum* Röll, Syst. der Torfm. Flora, 1886.

Plants slender and delicate like S. Warnstorfii or strong and robust like S. Russowii, in looser and denser, higher or lower tufts; color pale, grayish green to grass-green, the heads often brown, fine rose-color, or violet red.

Wood cylinder whitish or straw-yellow, very seldom in some parts of the stem with a flush of red; cells pitted.

Stem cortex composed of three or four layers; cells of medium width and thin-walled, the outer walls of the peripheral layer with very distant irregularly disposed membrane-thinnings which often, however, appear like ringless pores. Inner cells porose.

Stem leaves from a broad base deltoid, not linguiform, above at the often abruptly contracted apex truncate, dentate, usually involute and bordered at the edge; the border much widened below, and constructed of very narrow green pitted cells. Hyaline cells in the whole middle part of the leaf broad, in the upper half almost rhombic, in the lower rhomboidal, often once or several times divided by obliquely transverse walls, and with membrane-plaits; without fibrils and pores oftener than with them in the upper part of the leaf: the hyaline cells of the leaf-base with large saccate extensions; auricles small.

Fascicles mostly five-branched, the three stouter branches sometimes long and much attenuated to the point, sometimes shorter and abruptly pointed, spreading in very different directions from the stem, *five angled through the distinctly five-ranked arrangement of the leaves.* Retort cells of the branch cortex with slightly recurved neck, and a large aperture at the summit. Branch leaves closely or loosely imbricated, never secund, small, ovate lanceolate, at the usually round-truncate involute-edged and dentate apex bordered by two or three rows of narrow cells. The inner surface in the upper part with very small, isolated, ringed pores, especially in the upper and lower cell-angles; in the broader part of the leaf, near the margins, down to the base with large pores usually without rings. Outer surface from apex to base with numerous pores along the commissures, those near the apex strongly ringed, much larger than in S. Warnstorfii and not round but semicircular; below becoming gradually larger. Near the margins these pores are in part opposite to the inner pores, thereby producing complete perforations; leaves with a plait in the middle of the basal part; hyaline cells with membrane-plaits.

Chlorophyllose cells in cross-section triangular to trapeziform, placed on the inner side of the leaf between the hyaline cells and always free; on the outer side often enclosed by the (here more convex) hyaline cells, or free. Lumen large, triangular; the walls all around equally thick.

Commonly monoicous, more rarely dioicous; ♂ branches short, in the antheridium-bearing part clavate-thickened and always red or violet, after flowering lengthened and attenuate-pointed. Perigonial leaves quite similar to the rest of the branch leaves in form and cell net-work, but nonfibrillose and nonporose in the lower half. Perichætial leaves large, ovate, above drawn out to a longer or shorter, emarginate, involute-edged apex; broadly bordered; in the lower half constructed entirely of long rectangular pitted cells, in the upper part of both kinds of cells; hyaline cells rhombic to rhomboidal, once or several times divided. Fruit not rare; spores fine yellow, quite smooth, 0.021 to 0.025 mm. diam.

Var. *roseum* (JURATZKA.) Tufts with the head now lighter, now darker red or violet-red, the other parts of the plants greenish or whitish.

f. **dasy-homalo-anoclada** WARNST. Tufts very dense; branch-fascicles closely approximate, stronger branches horizontal-spreading and in the upper part of the plant ascending.
New Hampshire, Mt. Lafayette, 3,000 ft. (*Faxon*).

f. **dasy-homalo-drepanoclada** WARNST. Like the preceding form, except that the stronger branches are partly horizontal-spreading and partly falcately bent downward.
N. Hampshire, Mt. Lafayette, 3,500 ft. (*Faxon*).

Var. **viride** WARNST. Plants green or grayish green in the upper part, almost without a trace of red, in the lowest parts generally bleached out.

f. **homaloclada** WARNST. The stouter branches usually all more or less horizontal-spreading.
Vermont, Willoughby Lake, 1,200 ft. (*Faxon*).

S. quinquefarium in the level low country is rare, but in the mountainous regions of northern Europe it is a common moss. When once well understood it may usually be recognized with certainty even under the hand lens. Several graceful forms with curved-spreading branch leaves are carefully to be distinguished from S. Warnstofii which they closely resemble. The form of the stem leaves and the pore structure of the branch leaves in S. quinquefarium, however, are totally different, so that the two species by these alone are easily distinguished from each other. It must certainly be widely diffused in North America.

β. Stem leaves usually in the upper half and even lower down with numerous fibrils and pores, but often also on the same stalk with very few fibrils or none at all; triangular-linguiform with a truncate dentate apex slightly or not at all prolonged. Superficial cells of the stem cortex without pores. Wood cells variously colored, often red, never brown. Branch leaves never five-ranked, appressed, when dry lustreless; mostly monoicous; male branches red.

8. *S. acutifolium* (EHRH. *ex parte*) RUSS. ET WARNST. in Verh. der bot. Ver für Brandenb. Jahrg. 1888, p. 112.

Plants extremely variable in color and habit. In tufts loose or dense, high or low, whitish, green, yellowish-green, or pale-rose to purplish red, or variegated. The individual plants now weak and slender, now strong and robust like S. Russowii.

Wood cylinder whitish or yellowish-green, very often red, but never brown.

Stem cortex formed of 3 or 4 strata of middling-broad, thin-walled cells; outer walls poreless, inner walls with small pores.

Stem leaves smaller or larger, narrower or wider, the length being, at most, three and one-half times the width of the base. More or less distinctly narrowed from the base upward, often with the edges slightly incurved; isosceles-triangular to triangular-linguiform, with a truncate, dentate, involute-edged, sometimes slightly prolonged point; the broader or narrower border in normally developed plants always much widened downward; hyaline cells in the upper half of the leaf rhomboidal, usually divided by only one transverse wall into two daughter-cells, and on the same plant sometimes with fibrils and with pores on the back, sometimes with neither.

Branch-fascicles consisting of two stouter divergent and one or two weaker pendent branches, sometimes closely approximate, sometimes more distant, according to the drier or wetter stations. Branches long or short, and diverging in very different directions from the stem, *always teretely leaved.* Branch leaves longish-ovate to ovate-lanceolate, with an involute margin at the usually round-truncate and dentate apex, very narrowly bordered, generally closely imbricate, more rarely erect-spreading, *never distinctly five-ranked, never secund, never squarrose; lustreless when dry;* with an inwardly projecting longitudinal plait in the middle base, and with delicate plaits in the membranes of the hyaline cells. Pores on the inner surface in the upper part almost exclusively in the upper and lower cell-angles, small and strong-ringed, in the middle and basal parts most numerous near the edges, large, round and weak-ringed or ringless. On the outer surface with very numerous large pores along the commissures, which toward the base of the leaf become gradually larger and show faint rings; these rings often disappear entirely at the base of the leaf and near its margins, and the pores are situated in the middle of the wall between the fibrils.

Chlorophyllose cells in cross-section triangular to trapeziform, placed on the inner side of the leaf between the here less convex hyaline cells and therefore always free, on the outer side of the leaf either enclosed or partially free.

Monoicous, more rarely dioicous; ♂ branches in the antheridium-bearing part clavate-thickened and red, after flowering attenuated at the tip. Perigonial leaves broader and shorter than the sterile branch leaves, above abruptly contracted to a short, truncate and dentate tip, in the lower half either quite free from fibrils and pores or partly with delicate imperfect fibrils. Perichætial leaves large, ovate, in the lower part usually constructed entirely of elongated, rectangular, pitted, chlorophyllose cells, in the middle and upper part, of both kinds of cells, and in the truncate recurved point entirely of short, narrow-rhomboidal green cells. Hyaline cells often many times divided, but nearly always free from fibrils and pores. Margin with a broad border formed of narrow cells.—Macrospores yellow, papillose, 0.025 to 0.030 mm. diam. Microspores in separate smaller and, when empty, urnshaped capsules on separate plants mixed with the macrosporogonium-bearing fertile tufts, yellow, with 5- and 6-angled polyhedron-faces, 0.012 to 0.013 mm. diam.—Commonly fruiting.

In North America as common as in Europe, and likewise as remarkably rich in forms.

Var. **purpurascens** WARNST. Plants, in the upper part especially in the capitulum, beautiful rose, to purple-red, below paler but without admixture of green.

N. Hampshire, Crawford's, 1,900 ft., Franconia, 1,000 ft.; Mass., Boston, 50 ft., (*Faxon*); Essex Co., 75 ft. (*Sears*).

Var. **versicolor** WARNST. Tufts above, especially in the heads, of very different grades of red, below more or less green, plants sometimes speckled with red and green.

N Hampshire, Crawford's, 1,900 ft.; Franconia, 1,000 to 1,500 ft.; Mass., Mt. Graylock, 1,500 ft., Dedham, 75 ft. (*Faxon*).

f. **robusta**, s. f. **catoclada** WARNST. Plants very stout, mostly in very thickly compressed low tufts, spreading branches long and reflexed directly downward.

Vt., Sutton, 1,000 ft. (*Faxon*).

Var. **flavo-rubellum** WARNST. Plants faint reddish mixed with pale yellow.

N. Hampshire, Crawford's, 1,900 ft. (*Faxon*).

Var. **viride** WARNST. Tufts above light or grayish green or dark green, in the lower parts of the stems faded out.

Mass., Boston., 50 ft., Milton, 500 ft. (*Faxon*).

Var. **pallescens** WARNST. Whole plant whitish, or in the coma slightly tinged with pale greenish, reddish or yellowish, and below it whitish or faintly greenish; dark green entirely absent.

N. Hampshire, Crawford's, 1,900 ft.; Mass., Boston, 50 ft., (*Faxon*).

f. **dasy-drepanoclada** Warnst. Tufts as well as the branch-fascicles extremely compact, spreading branches comparatively short, slender and usually falcate-recurved.

N. Hampshire, Mt. Washington, 5,000 ft. (*Faxon*).

γ. Stem leaves large, isosceles-triangular, drawn out to a longer or shorter truncate, dentate, involute-edged point. Border broad and much widened downward; hyaline cells usually completely nonfibrillose, rarely with rudimentary fibrils at the apex; many times divided and with membrane-plaits. Wood cylinder variously colored. Branch leaves comparatively large, *glossy when dry*, usually loosely imbricate, often with curved erect spreading to squarrose tips. Generally monoicous, rarely dioicous. Male branches red.

9. *S. subnitens* Russ. et Warnst. in Verh. d. bot. Ver. für Brandenb. Jahrg. 1888, p. 115.

Syn.: *S. acutifolium*, var. *plumosum* Milde, Bryol. Sil., p. 382 (1869).—var. *luridum* (Hüben.) Aongstr. in litt. ad Gravet (1876).—var. *lætevirens* Braithw. Sphagn. Eur. and N. Am. (1880).—varr. *squarrosulum*, *luridum* (Hüben.), *laxum* Warnst. Eur. Torfm., p. 48-50 (1881)—var. *Schillerianum* Warnst. Flora (1882).—var. *aquaticum* Schlieph. in litt. 1883. Hedw. 1884.—var. *luridum* f. *plumosa*, *violacea*, *lætevirens*, *squarrosula*, *deflexa*, *stricta*, *limosa*, *elongata* Warnst. Sphagnol. Rückbl. Flora 1884.--var. *flavicomans* Card. Rev. Bryol. 1884.

S. plumosum Röll. varr. *submersum* ?, *luridum*, *elongatum*, *lætevirens*, *plumosum*, *violaceum*, *limosum*, *squarrosulum*, *Schillerianum* in Syst. d. Torfm. Flora, 1886.

S. luridum (Hüben.) Warnst. Hedw., 1886, p. 230.

This is among the strongest of the Acutifolia. *Plants when dry very soft and with more or less of metallic lustre.* Colors quite various, gray, or grass-green, pale yellow-green, yellowish-brown, violet to purple-red, not rarely passing into a dirty green or violet.

Wood cylinder greenish, whitish, violet to dark purple-red.

Stem cortex formed of 3 or 4 strata of cells, and usually on one side of the stem much more strongly developed and with much wider cells; all the cells thin-walled, the superficial rarely with isolated pores, the inner always with small pits. Stem leaves large, elongated, isosceles-triangular, broad at the base, not rarely with undulate margins in the middle, and above abruptly narrowed into a longer or shorter broad-truncate, dentate and involute-edged point, border broad, much widened downward, and formed of very narrow tubular pitted cells. Hyaline cells in the middle of the base wide and large, above rather shorter, rhomboidal, at the margins narrow, mostly without fibrils and pores, rarely with rudiments of fibrils and pores in the summit of the leaf; all 2 to 6 times divided and with delicate longitudinal plaits in the membrane. The apex sometimes formed only of small vermicular chlorophyllose cells.

Branches 3 or 4 in a fascicle, two stronger, spreading in very different directions from the stem, one or two weaker, pendent and appressed to the stem. Leaves of the stout, spreading branches larger or smaller, densely or loosely imbricate, often curved erect-spreading, seldom somewhat secund or squarrose, never distinctly 5-ranked; from an ovate base narrowed upward to a rather long, dentate, transversely- or roundly-truncate, involute-edged apex. Border 3 to 5 cell-rows in width. A short inwardly-projecting, longitudinal plait in the middle of the leaf above the base. Hyaline cells with numerous fibril-bands; pores on the inner surface almost all near the margins, large, round, often quite ringless and in the middle of the cell walls; in the apex of the leaf the pores are small, isolated in the upper and lower cell angles; pores on the outer surface much more numerous, in the upper $\frac{2}{3}$ to $\frac{3}{4}$ of the leaf large, ringed, semi-elliptic, on the commissures, those that are near the margins being in part opposite the inner pores and thus forming complete perforations of the leaf; pores near the base of the leaf very large without rings and between the fibrils in the middle of the cell-wall. Leaves of the pendent branches in the upper $\frac{3}{4}$ of the inner surface with large round mostly ringless pores in the middle of the cell-walls or in the angles, pores on the outer surface the same as in the other leaves.

Chlorophyllose cells in cross-section isosceles-triangular to isosceles-trapeziform (always the latter in the apex), placed between the hyaline cells on the inner side of the leaf and always free, on the outer side enclosed or free; hyaline cells convex on both sides, but more convex on the outer.

Mostly monoicous, more seldom dioicous; ♂ branches in the antheridium-bearing part reddish-violet, when young short and thick, later lengthened and attenuate at the end. The perigonial leaves not different from the rest of the branch leaves in form and anatomical structure, but near the base without fibrils and pores or with delicate incomplete fibrils. Perichætial leaves large, ovate, the edge very broadly bordered in the upper part and emarginate at the rounded truncate apex, below formed entirely of long rectangular pitted chlorophyllose cells, from the middle upward of both kinds of cells, the apex of small green cells only. Macrospores yellow, papillose, 0.025 to 0.031 mm. diam. Fruit very common.

This species is distinguished from S. acutifolium, especially *by the peculiar gloss of the branch leaves, and by the stem leaves, which are mostly without fibrils, are protracted into a longer or shorter point, and have their hyaline cells many times divided;* from the larger, stouter forms of S. quinquefarium it recedes by its longer-pointed, not five-ranked branch leaves, and by its differently shaped stem leaves. By the way, it may here be mentioned that S. quinquefarium also occasionally shows a faint lustre in the branch leaves. Incompletely developed forms may easily be mistaken for *S. molle* SULLIV., whose stem leaves, with respect to their shape and their narrow border, have a remote resemblance to those of such immature forms. In this case the distinctive mark is the distantly toothed margin of S. molle in the upper half of the branch leaf, which occurs in no other species of this group.

Var. *flavicomans* CARD. Rev. Bryol. 1884, No. 4, p. 55. Plants very stout, in lax or dense, rather deep tufts, mostly yellowish-brown like S. fuscum. Wood cylinder blood-red; superficial cells of the stem cortex with single pores; stem leaves without fibrils or in the upper part fibrillose. Branch leaves large, longish-ovate, apex broad-truncate and dentate, shining when dry.

Miquelon Island (*Delamare*). Samml. Europ. Torfm. Serie I, no. 77.

Var. **viride** WARNST. Plants in the upper part gray to grass-green, below bleached out.

Mass., Brookline, 75 feet (*Faxon*).

Var. **obscurum** WARNST. Plants very stout, in high loose tufts. Color in the upper part a mixture of grayish-green and pale, dirty brown; below, brownish. General color a dusky, indefinite brownish green.

Mass., Brookline, 75 feet (*Faxon*).

c. Stem leaves from a narrower base widened upward to the middle and thence produced to a longer or shorter broadly truncate, dentate point; border narrow and of nearly equal breadth from apex to base; with or without fibrils in the upper part. Wood cylinder always yellowish. Branch leaves loosely imbricated, somewhat shining, the upper margins minutely and remotely dentate; monoicous; male branchlets pale reddish.

10. *S. molle* SULLIV. Musc. Allegh. p. 50 no. 205 (1846).

Syn.: *S. tabulare* Sulliv. Musc. Allegh. p. 49 no. 204 (1846).
S. molluscoides C. Müll. Synops. I. p. 99 (1848).
S. tenerum Sull. et Lesq. Musc. Bor.-Am. I Ed. no. 11 (1856).
S. Mülleri Schpr. Entw.-Gesch. d. Torfm. p. 73, no. 10 (1858).

N. Carolina, Georgia, New Jersey, Alabama, Florida, Louisiana (*Langlois*).

II. Sphagna cuspidata.

A. *Branch leaves porose but always without fibrils.*

a. Pores on the outer side of the leaf rather large, 0.010 to 0.012 mm. diam., elliptic, always in one row in the middle of the cell-wall, 6 to 16 in a cell.

11. *S. macrophyllum* BERNH. MSS. Brid. Bryol. Univ. I. p. 10 no. 8 (1826).

Syn.: *Isocladus macrophyllus* Lindb. in Oefvers.V. Ak. Förh., 19, p. 134 (1862).

New Jersey, Carolina, Louisiana, Mississippi, Alabama, Florida.

This fine characteristic species is placed by Lindberg, together with the next following, in a separate group ISOCLADUS, whilst Cardot includes them in his SPHAGNA MACROPHYLLA. Both seem to me to be in the wrong, for the two species in question, with respect to the form of their stem leaves and branch leaves, and also as to anatomical structure, fit well into the CUSPIDATA. Still another species of this group, *S. sericeum* C. MULL. (Syn.: *S. Holleanum* Doz. et Mlkb.; *S. seriolum* C. Müll.) from Sumatra also has no fibrils in the leaves and yet there can be no question that it belongs to the CUSPIDATA. Other species of the Cuspidatum group (e. g. *S. Lindbergii* Schpr. and certain acquatic forms of *S. cuspidatum* (Ehrh.) Russ. et Warnst.) also possess uniform or at least nearly uniform branches.

The perichætial leaves of S. macrophyllum become much larger toward the summit of the branch; they are broadly oval, with the margins narrowly bordered; they are formed of the two kinds of cells and run out into a bluntish, denticulate point. The hyaline cells are narrow and long, but towards the apex broader and shorter, and like the stem leaves and branch leaves show no trace of fibrils. On the outside, however, there are round pores in the middle of the cell-wall, which become scarcer toward the apex, and especially prefer the upper angles of the cells. The capsules are small, and when empty of spores urn-shaped, as in S. cuspidatum The spores are yellow, smooth and 0 030 to 0.035 mm. diam. It is very strange that the male plant still remains quite unknown, and yet it can not be very difficult to find it in the localities where the species fruits. I beg leave, therefore, to earnestly urge all North American bryologists, who are interested in Sphagna, to direct their attention particularly to a search for the male plants of S. macrophyllum. This should be done in the winter months in which, as is known, the Sphagna bloom.

b. Pores on the outer side of the leaf very small, 0.004 to 0.005 mm. diam. in one or two rows in the middle of the cell-wall, 40 to 65 in a cell.

12. *S. Floridanum* (AUST.) CARD. in Rév. des Sphaignes de l'Amerique du Nord (1887).

Syn.: *S. macrophyllum,* var. *Floridanum* Aust. in Bull. Torr. Bot. Club vii, p. 15 (1880).

S. cribrosum Lindb. in Eur. och Nord. Am. Hvit-mossor (1882).

Louisiana *(Langlois)*, Florida *(Austin)*.

Since Austin had previously distinguished this species as S. macrophyllum var. Floridanum it was not justifiable for Lindberg in Hvit-mossor to set up a new name for it, and Cardot was quite right in retaining for the species Austin's name, S. Floridanum.

S. Floridanum stands, with respect to the pore-structure on the outer side of the branch leaves, in a similar relation to S. macrophyllum as *S. obtusum* WARNST. (1889 non 1877) does to *S. Mendocinum* SULL. ET LESQ. The last two species are likewise chiefly distinguished by the size of the pores on the back of the branch leaves. In S. obtusum these pores are extremely small, always show vanishing contours; and are only made visible by strong staining of the leaves; the pores of S. Mendocinum, on the contrary, are always larger and exhibit clearly defined boundaries. The male flowers as well as the fruit of S. Floridanum are yet unknown!

Neuruppin, Feb. 6, 1890.